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AUTHOR Korth, Willard W.; And Others
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ABSTRACT

This study examines the relationship between two measures of inquiry-verbal communication: The Science Classroom Activities Checklist (SCAC) and a modified form of the Parakh System of Interaction Analysis. The sample for this study consisted of ten randomly selected classrooms: three ninth-grade general science classrooms, six ninth-grade earth science classrooms, and one seventh-grade earth science classroom. Tape recordings of a single class session for each of the ten classes were used for the interaction analysis. The day following the recording session students in each class were given the SCAC, an instrument designed to measure the inquiry oriented activities, consisting of 55 true-false questions organized into seven categories. The Spearman Rank Correlation Coefficient analysis was used to relate the total score on the SCAC and the six areas of the interaction analysis. The highest coefficient was given between SCAC scores and percent of time attributed to teacher questions (.90). Pearson product moment coefficients between sections of the SCAC are also included in the results, indicating significant positive correlations for all but three of the coefficients. Results also indicate that inquiry makes up only a small part of what took place in the classrooms in this study; teachers generally dominated classroom discussions. (PR)

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A Study of the Relationships Between Measures of Teacher-Pupil Verbal Interaction and Student Assessment of Classroom Practices

Willard W. Korth, Jean Czelen, Gene W. Moser

University of Pittsburgh

Pittsburgh, Pennsylvania

SE 012 005

The practice of inquiry in teaching has become increasingly important at all levels in science education. However, the effectiveness of teachers in promoting the knowledge of inquiry processes is often questioned (Bingham, 1969). Recently, an attempt has been made to identify the significant factors in inquiry and the student behaviors characteristic of inquiry in the classroom. A project group of ESCS and McREL personnel have operationally defined inquiry as a "set of activities directed toward solving an open number of related problems in which the student has as his principal focus a productive enterprise leading to increased understanding and application," (Lee, 1970). On this basis, any assessment of classroom inquiry must be primarily concerned with the amount and nature of student and teacher activities. In addition, the nature of the verbal communication in the classroom should also reflect the emphasis upon inquiry processes.

This study was conducted to examine the relationship between two potential measures of inquiry-verbal communication as measured through the use of interaction analysis and classroom activities as assessed by the Science Classroom Activities Checklist. The Science Activities Checklist is an adaption of the Biology Classroom Activities Checklist (Kochendorfer, 1966). The wording on several items was modified to adapt them to use in junior high school science classes. In addition, two items specific to the classes tested were added. The instrument consisted of 55 true-false questions organized into seven sections. These seven sections were as follows:

Section A - Role of the Teacher in the Classroom

Section B - Student Classroom Participation

Section C - Use of Textbook and Reference Materials

Section D - Design and Use of Tests

Section E - Laboratory Preparation

Section F - Type of Laboratory Activities

Section G - Laboratory Follow-up Activities.

The observational instrument used was a modified form of the Parakh System of Interaction Analysis (Parakh, 1965). This system consists of sixty-three codes classifying pupil and teacher behavior for the quantification of observations. The predominant activity is coded every four seconds for approximately twenty to thirty minutes of each taped classroom session. The codes are then recorded on a matrix and utilized to analyze the type, sequence and content of teacher and pupil messages.

A random sample of ten junior high school teachers was drawn from a population of 42 teachers enrolled in the University of Pittsburgh Earth Science Project. This project is funded by the National Science Foundation and is designed to expand and improve the earth science offerings in the schools of Allegheny County. A random table of numbers was again utilized for the selection of classroom periods to be tape-recorded and administered the Science Classroom Activities Checklist. The final sample consisted of six 9th-grade earth science classrooms, three 9th-grade general science classrooms, and one 7th-grade science classroom. A total of 234 students participated in the study. A single class session was tape-recorded for each teacher and the students in each class were given the Science Classroom Activities Checklist on the following day. Tapes were then analyzed using the Parakh Modified Interaction Analysis System. Mean scores on the Science Classroom Activities Checklist were then calculated for each class for total score and for each section of the instrument.

Related Research

In a project conducted by Moser and Feldgoise, an attempt was made to increase the inquiry approach in the teaching of science by the use of interaction analysis (1968). In this study the statement was made that the objective of the inquiry approach is to affect a decrease in teacher-directed student response outputs and an increase in pupil self-initiated statements with more pupil - pupil flow. A significant aspect of this report was the development of the Six Set System of Interaction Analysis which views several events in series to detect the inquiry

model. Three modes were defined in the Six Set System: lecture with 6:0 and 5:1 sets of teacher and pupil messages; lecture recitation with 4:2, 3:3 and 2:4 sets; and the inquiry approach with 1:5 and 0:6 sets. Success in inquiry training was substantiated by the decrease in teacher outputs (teacher-talk) and the shift from lecture recitation into a higher representation in the inquiry mode. Suggested information conditions for the inquiry approach to occur were made in this study. These were; (1) teacher output must be in forms which promote student questioning, (2) teacher-generated events do not dominate the environment, (3) pupil-generated events must be in an inquiring mode in the form of explanations, facts, and questions, and (4) pupil-generated information flows are transmitted to other pupils.

A study relating to BSCS using the Flander's System of Interaction Analysis has been reported by LaShier (1966). This study was initiated to determine the relationship between certain aspects of the verbal behavior of student teachers and the achievements and attitudes of students participating in a BSCS Laboratory Block. A second purpose was to describe the difference in interaction patterns between direct and indirect groups of student teachers. This study showed higher achievement for students in the indirect classes; i.e., classes in which student participation was supported and encouraged. LaShier also found a higher amount of pupil-talk in the indirect group as compared with the direct group. Total lecture time accounted for 57% of teacher-talk for the direct group as compared with 44% for the indirect group.

Parakh (1968) conducted a study to determine how classroom behavior of teachers and pupils differ with regard to programs in use. He also questioned how these observable classroom behaviors are related to the pupils' understanding of science as a product of the process of inquiry. He reported the average teacher talked 79% of the total class time, whereas average pupil-talk was 16% of the total class time.

These studies seem to indicate that student involvement in the classroom dialogue is an important component of the learning process. However, the research cited does not attempt to investigate the types of activity in which students engage. The present study attempts to deal with both of these aspects of classroom inquiry.

Results of the Study

The results of this study are divided into three steps; (1) to measure the verbal behavior in the classroom through the use of interaction analysis, (2) to measure the amount of inquiry oriented activity using the Science Classroom Activities Checklist, and (3) to determine the relationship between these two measures.

Some of the data obtained through interaction analysis of the verbal behavior is given in Table 1. Teacher-talk (TS and TQ) made up an average of 80.3% of the verbal communication with teacher-questions accounting for 19.1%. Pupil responses to teacher-questions (PR and PV) took up 15.9% of the time, pupil self-initiated communications (PS and PQ) made up 3.7% of the verbal behavior. The over-all picture is thus one of a highly teacher-dominated environment. Not only is the teacher contributing over 80% of the verbal communication, but over 80% of the pupil messages are responses to teacher-directed questions. However, the amount of teacher talk varies from a low of 64.6% to a high of 97.3%

Use of the Six Set System suggested by Moser and Feldgoise (1968) confirms the extent to which teachers dominate the classroom verbal interaction (see Table 2). Only two classes show any evidence of what Moser and Feldgoise called the inquiry mode. Approximately 65% of the average class time is in the lecture mode with slightly less than 34% of the instruction classified as lecture-discussion.

The Pearson-product moment correlation was used to establish the relationship between sections of the Science Classroom Activities Checklist. These coefficients are found in Table 3. Section G (Laboratory Follow-up Activities) had the highest correlation coefficient (.90) with the total score suggesting that it may be a critical factor in the practice of using inquiry. All sections correlated highly

Table 1

Percentage of Digram Codes for Classrooms A-J*

Classroom	TS	TQ	PR	PV	PS	PQ
A	92.7	4.6	----	2.4	0.2	----
B	80.2	12.1	2.0	4.7	0.7	0.3
C	76.6	12.6	2.3	6.8	1.7	----
D	53.6	28.7	15.0	2.6	----	----
E	66.8	14.4	7.2	5.1	3.6	2.9
F	56.9	24.0	6.8	11.6	----	0.7
G	60.2	16.8	3.4	12.0	0.2	7.4
H	53.9	16.7	5.5	14.1	2.1	7.5
I	39.6	28.8	6.6	19.7	3.1	2.2
J	32.1	32.5	8.2	23.0	3.8	0.4
Mean	61.2	19.1	5.7	10.2	1.5	2.2

* TS = Teacher Statements

TQ = Teacher Questions

PR = Pupil Required Response to Teacher Question

PV = Pupil Volunteered Response to Teacher Question

PS = Pupil Self-initiated Statement

PQ = Pupil Question

Table 2

Percentage of Time Spent in the Three Output Modes

of The Six Set System

Classroom	% Lecture	% Lecture-Discussion	% Inquiry
A	100.0	0.0	0.0
B	87.0	13.0	0.0
C	84.2	15.8	0.0
D	76.7	23.3	0.0
E	69.6	30.4	0.0
F	76.7	23.3	0.0
G	59.2	40.8	0.0
H	39.7	56.2	4.1
I	33.7	59.0	7.3
J	24.1	75.9	0.0
Mean	64.9	33.7	1.2

with each other with the exception of Section D (Design and Use of Tests) which also had a comparatively low correlation with total score. This suggests an area that needs further investigation. It may be that teachers using inquiry fail to support this approach in their use of evaluative instruments.

Since the percent of teacher-talk seems to be a good indication of the teacher's domination of the classroom verbal behavior, we were interested in the relationship between its measure and the average total score on the Science Classroom Activity Checklist. The data is presented in Table 4. The Spearman Rank Correlation Coefficient which provides for the ranking of observations on the ordinal scale was used. The correlation coefficient between percent of teacher-talk and total score on the Activity Checklist was found to be -.79. The Spearman rank correlation was also calculated between total score and the six types of digrams used in the Interaction Analysis System. Total score correlated -.89 with the percent with TS, .90 with TQ, .62 with PV, .34 with PS, .89 with PR, and .37 with PQ.

The highest coefficient is obtained for the correlation between total score on the Science Classroom Activities Checklist and percent of time attributed to teacher questions (.90). Thus, classrooms with the higher average scores on the Activity Checklist displayed the greatest amount of questioning by the teacher and conversely, the lowest amount of teacher statements shown by a -.89 correlation coefficient. Pupil self-initiated statements and pupil questions did not seem to have any significant relationship to total score. However, it should be noted that these events made up less than 4% of the total verbal behavior.

Summary

This investigation was conducted to study the relationship between two potential measures of inquiry in junior high school science classes. Ten randomly selected classes were given the Science Classroom Activity Checklist and the verbal interaction pattern of the classrooms was analyzed.

Table 3

Pearson Product Moment Correlation Coefficients Between

Sections of the Science Classroom Activity Checklist

	Total Score	Section A	Section B	Section C	Section D	Section E	Section F	Section G
Total Score		.71	.73	.81	.27	.76	.64	.90
A	.71		.45	.49	.19	.75	.15	.61
B	.73	.45		.59	.45	.37	.41	.57
C	.81	.49	.59		.30	.48	.58	.53
D	.27	.19	.45	.30		.15	-.34	.03
E	.76	.75	.37	.48	.15		.31	.71
F	.64	.15	.41	.58	-.34	.31		.70
G	.90	.61	.57	.53	.03	.71	.70	

Section A - Role of the Teacher in the Classroom

Section B - Student Classroom Participation

Section C - Use of Textbook and Reference Materials

Section D - Design and Use of Tests

Section E - Laboratory Preparation

Section F - Type of Laboratory Activities

Section G - Laboratory Follow-up Activities

Table 4

Percentage of Teacher Talk and Corresponding Average
Total Score on Science Classroom Activity Checklist

Classroom	% Teacher-Talk	Average Score on SCAC
A	97.3	21.4
B	92.3	24.0
C	89.2	26.1
D	82.3	29.8
E	81.2	29.3
F	80.9	26.5
G	77.0	29.5
H	70.6	25.5
I	68.4	29.9
J	64.6	33.5
Mean	80.3	27.6
S.D.	9.7	3.3

Total scores on the SCAC showed a positive correlation with the percent of time spent on teacher-questions and a negative correlation with the quantity of teacher-statements. It appears that teachers who engage in more of the activities assessed by the Science Classroom Activity Checklist also spend a greater portion of the time questioning students and less time imparting information.

The data indicates that inquiry makes up a small part of what goes on in the classrooms included in this sample. The average score on the SCAC was 27.6 out of a possible 55 points. Teacher-talk averaged 80.3% of the verbal interaction and student self-initiated communications were observed less than 4% of the time. It appears that the teachers observed were, for the most part, unable or unwilling to engage in any substantial amount of inquiry-oriented classroom activity. This notion is supported by the extent to which teachers dominated classroom discussions. Another problem, which needs additional investigation, arises from the suggestion that even where some inquiry occurs it does not seem to change the evaluative procedures used by the instructors.

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